

## CLAIMS

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What is claimed is:

1. A head-related transfer function model for use with 3D sound applications, comprising:
  - a plurality of Eigen filters;
  - a plurality of spatial characteristic functions are adaptively combined with said plurality of Eigen filters; and
  - a plurality of regularizing models adapted to regularize said plurality of spatial characteristic functions prior to said respective combination with said plurality of Eigen filters.
2. The head-related transfer function model for use with 3D sound applications according to claim 1, further comprising:
  - 15 a summer operably coupled to said plurality of combined Eigen filters combined with said plurality of regularized spatial characteristic functions to provide said head-related transfer function model.
3. The head-related transfer function model for use with 3D sound applications according to claim 1, wherein:
  - 20 said plurality of regularizing models are each adapted to perform a generalized spline model.
4. The head-related transfer function model for use with 3D sound applications according to claim 1, further comprising:
  - 25 a smoothness control operably coupled with said plurality of regularizing models to allow control of a trade-off between localization and smoothness of said head-related transfer function.

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5. A head-related impulse response model for use with 3D sound applications, comprising:

- a plurality of Eigen filters;
- a plurality of spatial characteristic functions are adapted to be respectively combined with said plurality of Eigen filters; and
- a plurality of regularizing models adapted to regularize said plurality of spatial characteristic functions prior to said respective combination with said plurality of Eigen filters.

10 6. The head-related impulse response model for use with 3D sound applications according to claim 5, further comprising:

- a summer adapted to sum said plurality of combined Eigen filters combined with said plurality of regularized spatial characteristic functions to provide said head-related impulse response model.

15 7. The head-related impulse response model for use with 3D sound applications according to claim 5, wherein:

- said plurality of regularizing models are each adapted to perform a generalized spline model.

20 8. The head-related transfer function model for use with 3D sound applications according to claim 5, further comprising:

- a smoothness control in communication with said plurality of regularizing models to allow control of a trade-off between localization and smoothness of said head-related transfer function.

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9. A method of determining spatial characteristic sets for use in a head-related transfer function model, comprising:
  - constructing a covariance data matrix of a plurality of measured head-related transfer functions;
  - 5 performing an Eigen decomposition of said covariance data matrix to provide a plurality of Eigen vectors;
  - determining at least one principal Eigen vector from said plurality of Eigen vectors; and
  - projecting said measured head-related transfer functions
- 10 back to said at least one principal Eigen vector to create said spatial characteristic sets.

  

10. A method of determining spatial characteristic sets for use in a head-related impulse response model, comprising:
  - constructing a covariance data matrix of a plurality of measured head-related impulse responses;
  - 15 performing an Eigen decomposition of said covariance data matrix to provide a plurality of Eigen vectors;
  - determining at least one principal Eigen vector from said plurality of Eigen vectors; and
  - 20 back-projecting said measured head-related impulse responses to said at least one principal Eigen vector to create said spatial characteristic sets.

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and

11. Apparatus for determining spatial characteristic sets for use in a head-related transfer function model, comprising:
  - means for constructing a covariance data matrix of a plurality of measured head-related transfer functions;
  - 5 means for performing an Eigen decomposition of said covariance data matrix to provide a plurality of Eigen vectors;
  - means for determining at least one principal Eigen vector from said plurality of Eigen vectors; and
  - means for back-projecting said measured head-related 10 transfer functions to said at least one principal Eigen vector to create said spatial characteristic sets.

12. Apparatus for determining spatial characteristic sets for use in a head-related impulse response model, comprising:
  - 15 means for constructing a covariance data matrix of a plurality of measured head-related impulse responses;
  - means for performing an Eigen decomposition of said covariance data matrix to provide a plurality of Eigen vectors;
  - means for determining at least one principal Eigen vector 20 from said plurality of Eigen vectors; and
  - means for back-projecting said measured head-related impulse responses to said at least one principal Eigen vector to create said spatial characteristic sets.

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